RESEARCH HIGHLIGHT

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Preserved Wood as a Potential Source of Arsenic and Fungi in the Foundation Walls of Homes

INTRODUCTION

Many Canadian homes have been built on preserved wood foundations (PWFs). For many years, chromated copper arsenate (CCA) and ammoniacal copper arsenate (ACA) were the most widely used agents to treat wood intended for such below-grade use. Recently however, concerns have been raised that these preservative chemicals may be released from the wood and contaminate adjacent areas. Additionally, it is known that fungi and other microbial contaminants can colonize building materials and assemblies, especially when they are exposed to excessive moisture.

Under ordinary conditions, PWF walls represent potential indoor contamination sources because air leakage from the wall cavities into a house over a long period of time can be significant. However, when wall systems are opened for inspection or repair, contaminants can be released on a larger scale.

The purpose of this study was to obtain information on the airborne levels of fungi and arsenic within the enclosed PWF wall cavities of existing homes. To this end, the field study investigated the airborne levels of both arsenic and fungi in the finished basement wall cavities of 10 Saskatchewan houses differing in age and physical condition, but all constructed with PWFs.

RESEARCH PROGRAM

This research highlight is based on a 2004 study funded by the CMHC External Research Program (ERP Project Report 6585-F060, "PWF Wall Cavity Arsenic and Mold Study").

Ten houses of varying ages were selected in locations throughout the province of Saskatchewan. At each house, an initial visual assessment of the foundation was performed to gather general information on the history and condition of the foundation, and to look for physical indications of current or past moisture management problems.

At each house, samples were collected from each of the exterior foundation walls. All of the sampling sites were chosen on insulated and gypsum board sheeted exterior walls with intact air/vapour barriers. All samples were taken from the lower portion of the wall cavity, approximately five centimeters above the bottom framing plate. Since arsenic and mold may exist as (or on) fine particles that would settle in closed wall cavities, sampling in the lowest portion of the wall was expected to measure the area of highest concentration of these contaminants within the wall cavity.

Sampling methods for both airborne arsenic and fungi employed calibrated suction pumps to draw a measured volume of air through sampling media to collect the compound/substance of interest. At each location, a small hole was drilled through the interior wall cladding and the polyethylene air/vapour barrier and a sample probe was inserted into the center of the insulated wall cavity.

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The Health Canada 05 Tolerable Concentration for airborne arsenic (1996) is 7.8 µg/m³ (0.0078 µg/L), and the Saskatchewan Labour Regulations (1996) identify 0.01 mg/m³ (0.01 µg/L) as the 8-hour limit of exposure. Given that these are guidelines for maximum airborne arsenic concentrations, the test methodology was developed so that the airborne arsenic detection limit was 0.00039 µg/L (five per cent of the Health Canada guideline value).

NIOSH method 7300 (1994) was used to determine the total airborne arsenic concentration.The arsenic sampling system utilized a calibrated pump and flow meter to collect the air sample over an approximately two-hour period.

The airborne fungi sampling utilized an Air-O-Cell spore-trap to collect total airborne fungi. In most cases, the Air-O-Cell samples were taken for two minutes with a total air sample volume of 30 liters. Where the presence of a greater amount of debris was suspected in the wall cavity, the sample volume was reduced by a factor of two to minimize the likelihood of overloading the sample.

For each fungi sample, the analysis provided the total number of fungi present as well as a breakdown of the fungal types and their relative amounts. If the slides were too heavily loaded (overloaded) with fungi or debris, the concentrations of fungi could not be accurately determined, and the types present were not completely identifiable.

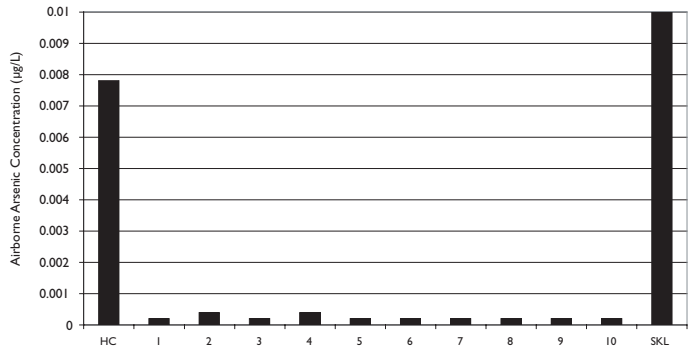
At each sampling site, the wall cavity air temperature and relative humidity measurements were taken concurrently with the airborne fungi.

FINDINGS

Arsenic

All of the airborne arsenic levels within the wall cavities were below or just reaching the minimum detectable value of 0.00039 µg/L. The study results indicated that none of the samples exceeded even five per cent of the Health Canada 05 Tolerable Concentration for arsenic. The highest wall cavity airborne arsenic concentration detected at each house is given in Figure 1.

While the measured wall cavity airborne arsenic levels do not indicate any significant release of arsenic from the wood framing into the interior wall cavity air, it should be emphasized that these values only account for arsenic that was present in the air and airborne particles at this level, and would not identify arsenic that was attached to the various surfaces within the cavity.



Where:
HC is the Health Canada 05 Tolerable Concentration for airborne arsenic, numbers 1-10 indicate maximum airborne arsenic levels measured at each house tested, and SKL is the Saskatchewan Labour Regulations 8-hour limit exposure limit for airborne arsenic.

Figure 1 Peak Airborne Arsenic Concentrations at Each Home and Reference Values

Fungi

Although there are currently no standards for interpreting Air-O-Cell airborne fungi sample results, large indoor concentrations of fungi relative to typical outdoor levels and/or the presence of relatively large amounts of certain types of fungi (that are not typical in outdoor air) may indicate the presence of a building-related fungi source.

Overall, the visual condition of the foundations did not appear to be a reliable indicator of the potential for fungal contamination within the wall cavities.

In Saskatchewan, the total outdoor airborne fungi concentrations frequently exceed 10,000 counts/m³ and the most prominent fungi types include *Ascospores, Basidiospores, Alternaria* spores, *Cladosporium* spores, *Epicoccum* spores and *Ulocladium* spores. Occasionally, small numbers of *Aspergillus/Penicillium* spores, *Amerospores* and other fungi types or fungi fragments were identified in outdoor air samples, but always as minor components of the total fungi present.

Approximately two thirds of the wall cavity airborne fungi samples had some type of unusual characteristics, suggesting that significant fungal growth within the wall cavities may have occurred. Unusual fungi characteristics were indicated by the presence of *Stachybotrys*, relatively large numbers of *Aspergillus/Penicillium* spores or *Amerospores*, or very high total airborne fungi concentrations (approximately 20,000 counts/m^3 or higher) in the wall cavity air samples.

The other sample locations had relatively low levels of total airborne fungi, and the fungi that were identified consisted of common types and distributions of normally occurring outdoor air fungi. These wall cavity air sample results were consistent with ordinary outdoor air and were not considered to be indicative of the presence of significant mold sources.

Moisture is recognized as a dominant factor contributing to fungal growth in buildings. During the site monitoring, temperature and relative humidity levels in the wall cavities were measured. With the exception of two homes, which were known to be unserviced (no heat or electricity for several weeks prior to or during the testing), all of the wall cavities had similar temperatures and relative humidity levels. These conditions may not reflect the range of previous conditions that could have existed within the walls and did not appear to be related to the airborne fungi characteristics that were measured.

CONCLUSIONS

The results from the study indicated that:

1. Airborne arsenic levels in the exterior wall cavities of PWFs were consistently very low (at or below 0.00039 µg/L).
2. Wall cavity airborne fungi characteristics were highly variable, but frequently indicated the presence of significant fungal contaminant sources.
3. The visual condition of the exterior and interior surfaces of the foundation wall and reported history were not reliable indicators of the airborne fungi characteristics within the wall cavity.

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